ADDRESS

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BY

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ADDRESS.

LADIES AND GENTLEMEN:—

AMERICAN husbandry may be divided into two systems. The first exists where the farms consist of recently cleared lands, upon which vegetation has flourished for ages, decaying and leaving beds of decomposed organic matter, rich in the elements adapted to foster the growth of plants. Under such circumstances, the task of the farmer, though laborious, is comparatively simple, as he has merely to turn under the natural prairie sward, or clear away the forest, burn off the litter, scratch the surface with a brush-harrow, sow the seed, and wait for luxuriant harvests. This primitive system of agriculture, in which tillage and the securing of crops constitute almost the only branches of husbandry called into requisition, continues for a longer or shorter period, according to the natural richness of the soil. But on lands where the products of the soil, instead of decaying upon the ground, are annually removed and sent away to market, time brings about a different state of things. All the crops removed abstract certain elements from the soil, the possession of which constitute its fertility, so that impoverishment must ultimately ensue where no means have been adopted calculated to counteract the exhaustion. The trial is constantly making, in our older settlements, of increasing the extent of worn-down lands under cultivation, in order to make up for the diminished products under the scathing system. But although the same number of bushels may thus be annually raised, the expenses, in labor, seed, &c., are greatly increased, and, in the end, ruinous consequences ensue; the poor farmers, after all their hard work, finding themselves sinking deeper and deeper into poverty and debt, until often reduced to hopeless bankruptcy. These causes have long been forcing the members of families to separate, and go to the right and to the left; not, however, for the same reasons which brought about the memorable separation of Abraham and his brother Lot, the increase of their flocks, but the reverse, the decrease of their cattle, and unremunerating harvests. Whilst our lands in this section of the country retained their natural fertility, the cost of labor being low and prices of produce high, farmers had need of little brain-work to enable them to get along prosperously. But now a far less favorable condition of things exists, the fertility of the soil being reduced so as to require great expense to keep it up, the prices of most kinds of produce being comparatively low, and the cost of labor, taxes, and almost all all other things increased. The great facilities now existing for transporting to our seaboard markets the products of the virgin soils of the almost boundless West, creates a competition which compels us, in the eastern section of the Union, to call in the aid of more skill, to give increased productiveness to the labor of our hands; and the most advantageous modes of enriching the soil, with the adoption of every improved implement and labor-saving machine, are subjects which our farmers are called upon to study diligently. Thus a new order of things is brought about, constituting what I designate the second or improved system of husbandry, that system which immediately interests those who are here on the present occasion.

Most of you are aware that science has of late years done wonders in advancing the useful arts in almost every department of human industry. Those branches in which the subjects or materials dealt with appealed most directly to the external senses, and could be most readily examined by measure and weight, were the first to be brought to high perfection. But many substances by which we are surrounded, and which exert the most active influences upon living animals and plants, as well as chemical effects upon all the various forms of dead matter, are either entirely invisible, like air, or so slightly apparent to the eye and external senses as to be beyond the reach of common modes of examination. When modern chemists first directed their attention to finding out the different elements entering into the constitution of plants, the primary step was to burn them and examine the ashes, which, it must be remembered, constitute a very inconsiderable proportion of their bulk or weight. These were found to consist of various matters, differing essentially from each other in their nature and properties, and representing what the tree or plant received from the soil, during its growth, comprising the two fixed alkalies, potash and soda, lime, silica or flint, phosphoric, sulphuric, and carbonic acids, and chlorine. More or less of each of these are removed from the soil in every crop.

As the ash remaining after burning constitutes only about six or eight parts in a hundred, and often a much smaller amount, of the substance burnt, it was still to be ascertained what became of those volatile parts dissipated in the flame and smoke, and forming much the largest proportion of the original bulk or weight. And this has been perfectly accomplished, chemists having contrived to catch those substances eliminated during combustion, and, by exact analytical processes, separate them into their elements, which prove to be the four gases, oxygen, nitrogen, hydrogen, and carbonic acid. Wonderful to relate, these four gaseous elements are found capable, through infinite combinations and changes wrought by subtile natural agents and vital processes, to form the innumerable products exhibited in different plants, such as saccharine juices, gums, jellies, oils, starch, perfumes, flavors, etc. The results of the varied combinations of a few primary elements are here vastly multiplied, like the countless numbers formed from a few arithmetical figures, the infinitely varied strains composed out of a few musical notes, or the numberless hues produced from the few primitive colors.

Science has thus made us acquainted with all the elementary constituents which plants require during their growth and development. With the knowledge of what plants need for their nourishment, we can readily infer what elements must be present in soils in order to supply each crop with the fertilizers best adapted to its wants.

Among the substances most extensively applied to land, in order to increase its fertility, is lime, which alone might furnish a profitable theme for such occasions as the present; and I do not think I can go amiss in employing some of the time allotted to me in directing your attention to certain of its properties, which, if more generally understood, would insure its more advantageous and economical use, and tend to lessen its waste and abuse. I do not propose extending my observations over the wide field which the topic presents, but shall limit them to the plainest exposition I can make of the nature and practical bearings of a few simple principles.

This valuable mineral fertilizer has been much misused in agriculture; depended upon alone where the want of fertility was owing to the absence of some other essential element, used in forms not at all adapted to the exigencies to be met, and applied with manures, the good qualities of which it neutralized or dispelled; in all such cases thrown away, first cost and labor of every kind included. If this Society had the amount annually lost by the misapplication and waste of lime, even within its own limits, it would be able to distribute princely premiums, and endow an agricultural college.

From ancient histories, we learn that lime was used in agriculture by the Greeks and Romans, the Gauls and Britons. Cato describes the modes of setting and burning lime-kilns in his day, and Pliny treats of some of the useful applications of lime to fruit-trees. From those remote periods of history up to the present day, it is probable that lime has never been dispensed with by husbandmen. The vast amount of experience accumulated through more than twenty centuries, and no one can tell how much longer, might be expected to have left no questions unsolved as to the utility of lime and its best modes of application. This, however, does not appear to be the case, and at the present day it is really ludicrous to hear the contrariety of opinion frequently expressed by farmers in giving their views of the value of this mineral fertilizer. One will say that it is all he desires to bring up and keep up the fertility of his land; another, that lime may be good for oats and grass, but is of no service to other crops; a third will speak favorably of its action on light soils, a fourth on heavy soils, whilst a fifth may declare that from all he has seen lime is of no use but to kill sheep sorrel. Now, such discrepancies of opinion can result only from an imperfect knowledge of the nature and properties of lime in its different forms, and ignorance of the conditions best adapted to secure its proper action.

In one form or another, lime may be regarded as the farmers' sheet-anchor, and a certain quantity of it is indispensable to all soils to secure their highest degrees of productiveness. Fortunately, it exists almost everywhere, to some extent.

Strictly speaking, lime is the oxide of a metal discovered by Sir Humphrey Davy, and by him called *Calcium*. This metal has never been found naturally in a separate state, because of its great attraction for oxygen. The lime in general use is obtained from a great many sources, the most common being marble and limestone rocks, chalky or marly beds, and deposits of the shells of marine animals. In all of these forms it is united with carbonic acid gas, and in a mild and comparatively inactive state. But after exposure to a high degree of heat, this gas is expelled, and the result is quicklime, a caustic and corrosive substance acting strongly upon any moist vegetable or animal matter, often rendering portions of these, formerly inert, soluble and fertilizing.

In its quick state, lime absorbs water with great avidity, and the lumps crumble into a powder on becoming slaked; which powder, from its being charged with water, is termed in chemical language the hydrate of lime, familiarly known to us in the preparations of fresh mortar and whitewash.

As a hydrate, lime is quite soluble in water, whereas in its state of a carbonate it is very insoluble. Contrary to the general law regulating the solubility of other substances, lime dissolves less freely in hot than in cold water.

Recently slaked lime exerts a wonderful affinity for carbonic acid gas, so that if left exposed to the open air—in which, you know, carbonic acid gas is always present—it soon absorbs enough to restore it to its former hard or chalky, insoluble, and inert condition.

To induce chemical action, solution seems indispensable. So also before anything can be absorbed by the roots of plants, it must be in a complete state of solution. Those who expect immediate chemical effects from lime, must therefore see that it is applied either in solution, or in the condition of a subtile powder calculated to favor its ready solution. The Chinese and Flemings, who, perhaps, use manures of various kinds with better results than any other people on earth, always, when practicable, apply them in a liquid state, having been taught by experience that plants thrive so much more rapidly when plied with fertilizers in a liquid form, or state admitting of ready solution. Should there be much delay between the times of taking from the kiln and spreading, lime, unless very well secured against the effects of the atmosphere, quickly returns to the state of a carbonate. Or even if spread immediately on being slaked, should a rain not soon come, it will have absorbed sufficient carbonic acid gas from the atmosphere to become more or less insoluble or inert. From ignorance of the rapid changes to which quicklime is subject, delays in its application are often allowed to take place, from which most of the advantages to be derived from it during a five or six years' succession of crops are lost. This view of the subject enables us to understand why it becomes necessary to renew the dressing of lime at the commencement of each four or five years' rotation, that which remains of former ample dressings having resumed its condition, in the lapse of time, of a very partially soluble carbonate. It also enables us to comprehend why applications of quicklime are just as necessary in districts where limestone abounds as in places distant from such deposits. Finally, it furnishes the reason why, according to general experience, much better results are obtained from frequent small dressings, than from heavy applications made at long intervals.

When it is intended to apply lime to ploughed ground, it should not be brought into the field until the ploughing is entirely or nearly completed, and near the time of sowing the crop. It must be kept in compact heaps, so as to expose the least possible surface. In slaking lime for the field, or, indeed, for any other purpose, care should be taken not to throw on too much water at first, as this interferes with the process, and causes lumps to remain which never crumble completely into powder. When spread, it should be immediately followed with the plough or harrow, by which more or less of it will be covered and partially protected from the atmosphere whilst attending the coming of dissolving rains. Where it has been deposited in a quick state upon headrows or ridges, the heaps may be slaked about a week before the time of spreading. The mode of slaking with water is always to be preferred. When left to the weather the process is very uncertain, depending mostly upon the precarious supplies of rain and dew, and involving always a considerable depreciation through carbonization.

To those who wish to make a little lime go as far as possible, or to secure its application at all times in the most soluble state, I would recommend its solution in a large quantity of water, so as to form what is commonly called milk of lime, and have this sprinkled over ploughed ground by means of a watering-cart, such as is commonly used in Belgium, and some other parts of

Europe, for the distribution of liquid manures, and in our cities for watering the streets. In places situated at some distance from the sea, where soda is deficient in the soil, salt water may be advantageously employed in making the solution. Ten bushels of freshly slaked lime used in this way will, I have no doubt, prove as efficient an application to an acre as fifty or one hundred bushels scattered over the surface of the earth, and left long exposed to the open air without rain. It is the prompt solution and ready diffusion of lime through the soil which secures its efficacy. Hence we find much smaller dressings answer on light porous sandy soils than will suffice for compact clay soils, the last being so difficult to penetrate.

Lime in its quick or soluble state should never be allowed to come into close contact with animal manures of any kind. Independent of the positive demonstrations which science may furnish of the truth of this precaution, there is a simple observation made about lime-kilns which affords the most incontestable evidence of the fact, namely, that droppings from the numerous horses generally employed in hauling, after becoming sprinkled with quicklime, are found to be almost valueless as manure. I presume that lime injures animal manures chiefly by rendering their extractive matters insoluble, and dislodging ammonia where this has had time to form.

There is an agency exerted by quicklime upon some soils which has not, I think, been much understood or properly estimated. I refer to its power to disintegrate the mineral constituents of almost all soils, so as to unlock their alkaline components and bring them into activity. These benefits are most conspicuous in soils resting on primitive rocks, where the crystals, remaining from former partial disintegration, are farther broken down, and the felspar and mica compelled to let loose their potash, soda, and magnesia, all of which contribute to promote the vigor of vegetation.

It is doubtless this power, exerted by lime in hilly districts of primary geological formations, that encourages the farmers in such places to use lime so freely and confidently, whilst those living on alluvial soils, at a distance from primary formations, often complain of receiving little or no advantage from the application of lime. In a recent conversation with one of the British Commissioners, sent over by Queen Victoria to attend the World's Fair at New York, he informed me that lime was very little used in England upon the alluvial soils, but mostly applied on the red clays and gravels. In some parts of Great Britain lime is used in immense doses. In Ireland, for example, it is sometimes spread upon old and sour pasture-leys at the rate of 400 bushels per acre, and in some of the English moors 1,500 bushels per acre have not been found too much.* Doubtless the lime in such cases was applied in the state of a carbonate.

The value of farm-yard and other animal manures depends mainly upon the amount of ammonia they contain, which extremely fertilizing salt exists chiefly in the state of a carbonate, and, consequently, is highly volatile at all times, and quickly dispelled by the addition of lime. Now it is a frequent practice to put more or less lime in or on the tops of heaps of barn-yard manure, which lime, if applied in a caustic state, cannot fail to drive off with rapidity the most fertilizing agent the manure-heap contained. Many persons depend upon the addition of ground plaster to fix the ammonia in their stables and pounds. But from the very limited and slow solubility of gypsum, compared with the rapidity with which the carbonate of ammonia flies away, it is questionable whether much good results from the practice. A far more effectual method of fixing the ammonia and preventing its escape, from stables, farm-yards, sinks, and places where animal manures are accumulated, is to sprinkle these from time to time with diluted sulphuric acid, in the proportion of one pint of acid to eight gallons of cold water. The vitriol must not, of course, be put into a metallic vessel. A common broom-corn brush, or whisk, may be conveniently employed to make the sprinklings, the frequency of which must be regulated by the pungency of the fumes coming from the manure-heaps which indicates the escape of ammonia. As sulphuric acid costs by the carboy only from two to two and a half cents per pound, the small expense incurred may be readily conceived. Those who make use of vitriol must guard against the danger of getting it upon their persons or clothes.

The caution against using lime to compost heaps extends only to those containing animal matters. To such as are frequently made up of muck, peat, stalks, straw, or other vegetable materials, which it is desired to break down and reduce to a proper condition for spreading, lime should be applied freely in its most caustic state.

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* **Farmers' and Planters' Encyclopœdia, article Lime.**

As to the efficacy of plaster of Paris or lime in the state of a sulphate to promote the fertility of soils, there is still more diversity of opinion among farmers than exists in regard to the value of carbonate and hydrate of lime. In large sections of country, and especially along the coasts of salt-water bays and seas, plaster is thought entirely useless. This may be owing to a decomposition effected by the muriatic acid derived from the salt-water through the agency of which the plaster is converted into a muriate of lime, a substance still more insoluble than lime in the condition of a sulphate or carbonate. In other sections of our country gypsum is so highly prized as a fertilizer, especially to clover and the grasses, that any price would be paid for it.

During the war with England, when foreign supplies were cut off and facilities did not exist of getting it from the extensive beds existing in the State of New York, a ton of plaster would bring as many dollars in Philadelphia, as a ton of Peruvian guano, or superphosphate of lime, at the present day.

The beautiful explanation given by Dr. Liebig of the beneficial effects produced by gypsum, are doubtless familiar to most of you. Having demonstrated the interesting fact that ammonia exists in all rain water, in the state of a volatile carbonate, Liebig asserts that this, on coming in contact with plaster in the ground, is seized and changed into a sulphate of ammonia, which, not being volatile, remains in the soil to be dissolved and absorbed by the spongelets of the roots of plants.

The error committed by those who rely solely upon lime to preserve their land in perpetual fertility, has been very happily illustrated by a writer in the *North British Review.*

"The plant," he says, "carries from the soil say ten substances. The soil is deficient in one of these, and the plant cannot grow; that one is lime or soda. You add it to the land, and your crops spring up luxuriantly. Rejoiced at this result, you add more lime, and your crops still grow well; for it requires the addition of 300 or 400 bushels to an imperial acre, to add one per cent. of lime to a soil which is 12 inches in depth. But after many crops the lime at length ceases to benefit the land, the crops are even smaller than they were before lime was first added, and the farmer is at a dead stand. Now what has he been doing all this time? He has been adding one thing only in his lime; he has been carrying off ten in his crops. Is it any wonder then, that after a lapse of years, the land should become poor in one or more of the other nine? The iron-smelter throws into his furnace his ore and his coal, but he gets no metal until he puts in lime also. He adds a dose of lime, and he draws off a running of metal. He adds more lime, and he procures perhaps more iron. But he very soon finds that lime does no farther good; he has melted out all the iron, he has exhausted his furnace; the stimulus of lime has no effect. He must add ore and coal again, and again he will procure his periodical flows of metal. So it is with the soil. The farmer who hopes, by the continual addition of one thing, to make his land produce continual good crops, hopes and acts against reason. It is his fault that the land has become exhausted, and the cure is in his own hands. Lime, therefore, does not necessarily 'impoverish the son.' But any treatment will ultimately make the land poorer which does not return to the soil all the things which the crops have carried off, and at least in equal proportion."

As the limestone found in this part of Pennsylvania is associated with a large amount of magnesia, some of the quarries along the Schuylkill giving over 40 per cent. of magnesia, it may be proper to say a few words relative to the part played by the last-named substance, which by some has been denounced as a most deleterious agent in soils. Sir Humphrey Davy partook of this opinion, and furnishes a very good explanation of the ill effects often noticed from the application of lime highly charged with magnesia. He says, "that the magnesia of the limestone is much sooner deprived of its carbonic acid than the lime; and, when applied to land, it rapidly absorbs this gas from the surrounding humus. But if there should not be a sufficient supply of this carbon, the magnesia will then remain in its caustic state, and act as a poison to many vegetables."

On most soils, especially those of a peaty nature, lime abounding in magnesia has been preferred to that without. Magnesia being found a regular constituent of almost every plant, and especially of the grain of all the cereal crops, I think it by no means difficult to assign a reason for the high favor in which the magnesian lime of this State is generally held by farmers.

But if there be various opinions in regard to the fertilizing qualities of lime in the forms we have mentioned, there can exist none respecting the supreme efficacy of the *phosphate of lime* as a promoter of vegetable growth and development. This is generally derived from the bones of animals, and hence it has been commonly called bone earth. Thousands and tens of thousands tons of bones are gathered from the ends of the earth and carried in ships to England, where they contribute so much towards raising those prodigious crops which so greatly excel even the luxuriant harvests of our most prolific virgin soils. In the State of New York, for example, premiums have been awarded for crops of 56 bushels of wheat to an acre, while in England awards have been made for crops of 88 bushels of wheat, 80 bushels of barley, and 108 bushels of oats per acre.

Comparatively few persons are aware that such a thing as a bone trade exists in our country, and fewer still that it is carried on to such a great extent. I have known a single vessel leave Philadelphia for England with no less than 700 tons of bones on board, enough to give a good dressing to 5,000 or 6,000 acres of our suffering farm lands, if converted into the superphosphates. Should others of our commercial cities contribute in like proportion, the aggregate amount of the precious phosphates annually sent out of our country, in which they literally constituted the fatness of the land, must, indeed, be immense. When ground and prepared for putting on their turnip and wheat fields, they cost in England from 60 to 75 cents per bushel. In this country they can be obtained for little more than half these prices. Very large quantities of bones are converted into superphosphate of lime, by solution in the sulphuric acid. This makes the fertilizing elements far more soluble and accessible to growing plants, and it is found that a comparatively small amount of bone earth thus prepared will feed a crop even more effectually than a far larger quantity applied in a crushed state. The analogy here holds good with the superior activity of lime applied in a state admitting of more ready solubility. The farmers in this country, those in the old setlements, at least, are now rapidly learning the value of the phosphate of lime furnished by bones, and when they come to understand their interests still more fully and generally, they will no longer suffer the strength of their fields to be transported to fertilize other countries.

One of the most important movements distinguishing the agriculture of the present day is the rapid extension of the use of concentrated fertilizers, such as guano, poudrette, ground bones, and the superphosphate and ammoniated superphosphate of lime prepared from these. We shall soon have added to this list, saltpetre, nitrate of soda, potash, sulphate of soda, phosphate of ammonia, with several others which have for a good many years been embraced in the extensive lists or price-currents of fertilizers kept for sale in the British markets, and freely used by English farmers on their crops.*

"I was the first," says the venerable Von Humboldt, in a recently written letter, "who brought guano to Europe, of which Klaproth and Vauquelin published an analysis. During forty years I preached, but always in vain, the usefulness of this substance; and in vain did I recommend its employment in fertilizing the fields of Europe. But it is only fifteen or eighteen years since it has at last become a great article of commerce." Will any one say that, had Von Humboldt's lot been cast on this side of the Atlantic, his wisdom would not have been suffered to sleep so long? We, as well as all Europe, have read for half a century his books, and the published analysis of guano, with statements of its long and extensive employment by the Peruvians with such marvellous effects, that it is now a common saying among them, "Guano, though no saint, can work miracles." But still, until very lately, we used no guano on our poor, exhausted fields. We had in this locality, not only Humboldt's instruction, but the guano itself, sent home many years ago by a naval officer in the Pacific. But the barrels containing this precious fertilizer were suffered to remain in the lumber corner of a cellar until the celebrity of guano became established in Europe and America, and extensive importations had been made. Accidental circumstances seem to have operated in bringing about the first regular importation of guano into England, which was made about the year 1840, not for agricultural, but for chemical purposes, as a means of supplying ammonia for making ammoniacal preparations. About this time chemists had made known the fertilizing powers of the salts of ammonia, as well as those of the phosphate of lime and other ingredients entering so largely into the composition of guano. Experiments were made in applying it to growing crops, and Europe and America were soon brought to recognize those wonderful fertilizing qualities known to the Peruvians since the reign of their Incas. The cry among farmers soon became, "Let us have more guano;" and now one hundred and fifty thousand tons per annum is a short supply for England, or even for the United States. Mr. Edwin Bartlett, of New York, to whom the first consignments of Peruvian guano were made in this country, recently informed me, that he was two years in effecting the sale of about one thousand tons, composing the cargoes of the two first guano ships sent to the United States. He forwarded to me from New York many tons of these original cargoes, much of which I employed on my poor fields in Kent County, Delaware, whilst still more was distributed among my agricultural friends in Pennsylvania, New Jersey, and Delaware. This was in the years 1845 and 1846. Mark the rapidity with which the use of guano has spread among us. Seven years ago, it required two years to dispose of two small cargoes of one thousand tons. In the present year, one hundred thousand tons is so short a supply that farmers are scrambling and drawing lots for a single ton, and thousands, this season, are compelled to go without any on their wheat crops. Fortunately science, which affords resources for almost every emergency, has placed within our reach concentrated fertilizers, some of which, pound for pound, are worth even more than guano, chiefly because their most fertilizing properties, volatile in guano, are fixed by chemical processes so as to secure them more durable effects. Without such aid, due to science alone, the farmers, who have become so well acquainted with the advantages to be derived from concentrated fertilizers, would be left, by the short supply of guano, in a very hopeless condition.

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* One of these lists may be seen in the *Farmers' Encyclopædia*, article Manures, page 788. The analysis of guano by the French chemists in 1806, is also to be found in the same work, under the head of Guano.

From a quite extensive employment of concentrated fertilizers during many years, I am prepared to give my decided testimony in favor of them, as, apart from their nourishing effects, they contribute so greatly to economize both labor and time. They occupy but little room in a barn, and, if of the proper kind, seldom if ever suffer loss from keeping. Hence, they may be always at hand ready for application in time of need. The great desideratum in farming, as well as all other pursuits, is a prompt return for all outlays. And this is one of the greatest advantages I have derived from an extensive employment of concentrated fertilizers. Some of these are beautifully granulated, so as to secure their equal distribution by machinery. To save time, and secure regularity of distribution, I have this year had a manurechest adapted to a drill for sowing wheat, so contrived that the concentrated fertilizer, which somewhat resembles the finest gunpowder, feeds with great regularity into the grain-tubes, so as to be buried and covered up with the seed. One of these machines is now on your exhibition ground. The fertilizer I employ is a finely-grained superphosphate of lime, charged with ammonia by a beautiful chemical process, through which the ammonia becomes fixed, and no longer capable of flying off, as is the case with this volatile salt as it exists in guano. In applying three hundred pounds of this chemical fertilizer to the acre, I prefer scattering at first one-half upon the ploughed ground previous to harrowing, and afterwards drilling in the remaining hundred and fifty pounds along with the seed, at one operation of the drill. By thus securing the proximity of the seed and its fertilizer, I expect to gain great advantages, probably equal to almost double the effects of the same quantity sown broadcast. The fertilizer I have named does not, like guano, injure the germ or sprout, unless when applied in undue quantities. These manures being sold by weight, like so much sugar or coffee, the farmers, from the force of association, are often startled at their price—and no wonder, when a comparison is made with the cost of the more common bulky manures which they have been used to spread in almost countless wagon-loads over their fields. But when it is known that of good guano, or superphosphate of lime, three hundred pounds to the acre will do as much, if not more for a crop, than thirty common loads of barnyard compost, they will find that they might often sell the latter, and replace it with a concentrated fertilizer, more efficient and more durable where the superphosphate is used, at one-third of what the manure would have cost when hauled and spread upon their fields. The lands in our good old Atlantic States, which sustained our ancestors at the beginning of our history, but which, over extensive districts, have become of late years so much exhausted as no longer to return remunerating crops, thousands of acres having been turned out into commons, left to grow up into woods, and become once more the haunts of the wild deer, are about to renew their pristine vigor, and perhaps made to exceed their ancient fertility. And to what are we to look for so desirable a result? Unquestionably to the introduction of concentrated fertilizers. When I consider the surprising advantages which I have myself obtained from numerous and extensive applications of these, I feel prepared to adopt, as fully demonstrated truths, the apparently transcendental views comprehended in the following prophetic passage from Dr. Liebig:—

"It must be admitted as a principle of agriculture, that those substances which have been removed from a soil must be completely restored to it, and whether this restoration be effected by means of excrements, ashes, or bones, is in a great measure a matter of indifference. A time will come when fields will be manured with a solution of glass (silicate of potash), with the ashes of burnt straw, and with salts of phosphoric acid, prepared in chemical manufactories, exactly as at present medicines are given for fever and goitre."*

One of the most familiar names in the history of British agriculture is that of Jethro Tull, who lived on his farm in Oxfordshire, in the beginning of the last century. He was the first in England who introduced the drill to sow seeds in rows, so as to admit of tillage between by the horse-hoe, an implement which he has also the credit of inventing. He was a great advocate for deep ploughing and thorough pulverization of the soil, believing that by such mechanical means, and the giving plants plenty of room to grow, with the constant stirring of the ground about them, they had every advantage. In fact, space and thorough tillage he regarded as equivalent to manure. Here the enthusiasm of this deep and original thinker led him astray, and the lights of true science were not then shining to show him his errors. In advocating the practice of deep ploughing, thorough pulverization, and frequent stirring of the earth, he did well; for, as a general rule, the roots of plants spread out as far and penetrate as deeply as the loosened soil will permit them. I have traced the roots of corn to the depth of three and a half feet in a loose gravel soil, and seen the roots of wheat, on the sides of a limestone quarry, descending in the crevasses twelve and fourteen feet below the surface where the seed was deposited. Tull's views were founded upon the subjection of everything connected with vegetable development to mechanical influences. His system of thorough culture and pulverization of the soil not only encouraged the roots to expand and reach whatever nourishment might come in their way, but it allowed the free admission of oxygen and water, with whatever else might be supplied from the atmosphere. So far as these important considerations are concerned, Tull's recommendations cannot be too highly praised. But chemistry had not then shown what plants were made of, and the elements indispensable for their subsistence. It is only when these elements of fertility are present, that the plough and the cultivator can work with the greatest efficiency. Cato, the Roman sage, whilst he pronounced the first and second great things in agriculture were *to plough*, adds that the third is *to manure*. And to this conviction, we are told, Tull's experience brought him in the end. For, after the crops had played their part on the soil newly turned up by his deep ploughing, exhaustion ensued, and thorough culture no longer produced the gratifying results by which it was first attended. In some parts of the Old World, where it is believed no work can prosper without the actual presence and aid of the priest, it is customary to have this functionary pass over the fields previous to seed-time and repeat certain prayers for the benefit of the coming crops. But, after performing the more solemn part of his duty, the better to insure the efficacy of his prayers, he drops a few significant hints, as he passes over the field, as to what is necessary to have done to favor the success of his spiritual invocations, and especially what places must have manure applied to them. So it is with us in our enlightened country; we may plough, and give the soil the most thorough cultivation ever contemplated by the enthusiastic Tull, but unless we supply the proper elements of fertility, it is in vain that we invoke the aid of Heaven for an increase.

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* Liebig's Organic Chemistry of Agriculture and Physiology.

Two or three years since there was a serious rupture between Sicily and England, which nearly ended in open hostilities. Indeed, Queen Victoria's war ships were actually ordered to Palermo, to overawe its refractory sovereign. And the cause of this disturbance of long-existing amicable relations was no other than some insignificant export duty his Sicilian Majesty contemplated laying upon the native sulphur supplied in such vast quantities from his volcanic domains. To have accomplished this would have suited the interests of one party very well, but it was soon discovered by the clever statesmen who guard so jealously all the interests of Great Britain, that they must get possession of sulphur at the least possible cost. Some might suppose that the chief object of the British, in amassing such immense stores of brimstone as they are known to import, was to have always on hand a plentiful stock of an indispensable material for the manufacture of gunpowder, to be used by her immense army and navy establishments. But this is a mere secondary consideration, the consumption of brimstone for warlike purposes being small, indeed, when compared to the amount used in the arts, and works promoted by peace. The extent to which sulphur is manufactured into the oil of vitriol in England is truly astonishing, this acid being the basis of many of the most extensive and productive manufactures which contribute so essentially to the prosperity of the country. Besides its employment to prepare materials for dyeing, bleaching, &c., a vast quantity of sulphuric acid is now used for agricultural purposes, chiefly in the preparation of artificial fertilizers, such as those made from bones, sulphate of ammonia, sulphate of soda, etc. As it is indispensable for the preparation of nearly all the artificial concentrated fertilizers, sulphuric acid must come to be regarded nearly as essential to the agricultural as it is to the manufacturing interests. I can speak knowingly of the advantages to be derived from this acid in agriculture, having used the present year alone, in the preparation of fertilizers for my crops, about four tons of strong oil of vitriol. And I am happy to be able to add that my cornfields are covered with more bountiful crops than they have ever produced since the distant day when they were first reclaimed from the primeval forests. Judging from my own experience, I do not hesitate to express my belief that the day is not far distant when the prices of our field-crops will be sensibly affected by the price of sulphur. In this country, a duty of 15 per cent. is now charged upon imported brimstone. They manage things better in England, where sulphur is admitted free of duty, and the British manufacturers and farmers, with their cheaper labor, thus have in their favor 15 per cent. advantage over our own. When their farmers are so well versed in the arts of fertilization, and receive such kind lifts, in various ways, from an acute government, no wonder the English take so comparatively little from us, in the form of breadstuffs, in exchange for their prodigious supplies of manufactured articles.

The English farmers, who, as we have already said, take our bones away from us, and turn them to such good account in raising such abundant crops, can teach us many other profitable lessons, if we would only condescend to learn from them. We have already referred to their surprising premium crops, and their average crops perhaps exceed ours just as much as their premium crops. To us, the expenses they go to in farming must appear enormous. The tenant often pays from $25 to $50 per acre yearly in rent, and finds half or the whole of the bought manures. He is, besides, burdened with various other expenses, among which are taxes, the very name of which would drive half of our countrymen mad. To farm it in the style they expect things managed in England, a tenant must possess a capital of $5,000 to $10,000, where the farms are from 200 to 300 acres, money enough to buy the fee simple of many of our best lands. To be sure, they get higher prices than we do for some of their products, and pay rather less for hands. But they do much more in the tillage of their crops, and purchase expensive fertilizers to an extent which, if stated, would to most of you appear incredible. Besides the millions of bushels of bones procured from all countries, I may add that, in the year 1849, according to official reports made to Parliament, the guano imported and used in England was not less than 150,000 tons, costing at least $6,000,000! The boldness with which they lay out money on their farms, compared with the timid course common among us, can only come from superior intelligence, securing greater results. By the exercise of superior skill, they contrive to meet all exigencies, and get back their outlays with remunerating profits, and this too in spite of the competition of Russian serfs, who work for almost nothing, and that of our own countrymen, many of whom have the advantage of operating upon the richest virgin soils.

England is obliged to import from other countries immense quantities of breadstuffs and provisions. But the amount of such importations would be far greater, were it not for the admirable course she pursues to reduce it by the introduction of such prodigious quantities of fertilizers. Every ton of bones, or guano, or nitrate of soda introduced from abroad, enables her farmers to raise many tons of wheat and animal food, which would otherwise have to be imported at great cost.

Intent upon every means of gathering fertilizers from the ends of the earth, the English agriculturists do not stop here, but import also the master spirits who can instruct them how to make the most of their resources. They lately sent to Dr. Justus Liebig, the celebrated agricultural chemist of Germany, to come over and make them better acquainted with those chemical discoveries which have rendered his name so famous. He accepted the invitation, and was received with the cordiality and respect due to a public benefactor. In our own country, a similar tribute has quite recently been paid to Professor J. F. W. Johnston, of England, well known for his researches into agricultural chemistry. He crossed the Atlantic by invitation of the New York State Agricultural Society, to deliver their annual address for 1849; and subsequently, in the beginning of 1850, delivered lectures, at Albany, upon the relations of the natural sciences with agriculture, before the members of the State Agricultural Society and State Legislature; and afterwards before the American Institute of New York, Lowell Institute at Boston, and Smithsonian Institution at Washington.

Now, gentlemen, such incidents are to be regarded as full of meaning. They certainly show a very different and much more favorable appreciation of the aids which science is capable of lending to agriculture than existed only a very few years since, when no one thought of inviting learned professors to come from distant countries for the purpose of lecturing on the scanty contributions which science had as yet made available to the farmer. But it is now certain that men of science have at last got hold of facts which enable them to teach the practical husbandman how to raise better crops at less cost, and feed stock with more economy and profit than he could do formerly. Such knowledge as this, which plays directly into the farmer's pocket, you will all join me in believing worth possessing.

If I may be permitted to refer again to my agricultural operations (to which I turn as a kind of solace from the labors and trying duties of a responsible profession), I am happy in being able to say that, within a few years past, farming has afforded me both pleasure and profit, beyond any anticipations formerly indulged. For these gratifying results I am almost entirely indebted to knowledge acquired from books, chiefly during the time I was preparing for publication the *Farmers' and Planters' Encyclopædia.* The mass of information derived from the best sources and condensed into that work, in passing through my hands, gave me, among other things, an insight into available fertilizers, and a confidence in their employment, which has led to the most cheering success.

Among the many useful objects that may be effected by agricultural societies is that of aiding in the diffusion of knowledge pertaining to rural affairs by distributing good books as premiums. This is done by many of our county and state societies, but generally to much less extent than would be most profitable. It is alleged in favor of money appropriations that dollars are the most effectual stimulants to competitors. Where these cannot read, now happily a very rare case, or have no children or young persons about them for whose intellectual improvement they feel an interest, the dollars may answer. But the value of the pittance allowed in premiums, in the majority of cases, is not for a moment to be compared to that of the possession of a good standard book, which remains a storehouse of useful knowledge, ready at all times to furnish its ample resources. In no other pursuit, calling, or profession, can progress be made without the aid of books, and the very best books are always sure to be demanded. How comes it, therefore, that in some sections of our country, farmers seem to have come to the conclusion that they can get along without the instruction to be gained from books? and that it is a real stretch of liberality in promoting the cause of agriculture, when they consent to have their names placed on the list of subscribers to some periodical issued at perhaps fifty cents per annum? The British farmers, of whose superiority I have said so much, have passed the age for primers, and take care to have good standard books at hand. I have one of these on my shelves, consisting of only three octavo volumes, which cost to import it $28. With the low estimate now generally placed upon books by our farmers, a work issued at that price would be a poor speculation for an American publisher. A significant motto for an ardent young farmer would be: *Good implements for the field, and good books for leisure hours.*

Gentlemen, it is needless for me to remind you that farmers are entitled to pride themselves upon the special importance attached to their calling, furnishing, as this does, to man and the beast that serves him, the immediate and indispensable means of subsistence. But our rural brethren must not rest their claims to high social position solely upon such considerations. If they possess the laudable desire to participate in the honors and distinctions open to competitors of all callings and professions, and especially if they wish to increase their capacities for the rational enjoyment of the rich gifts so liberally spread around us by a beneficent Creator, they must attend to the culture of their minds. Men of science and acute observation are now continually throwing out through a teeming press the most valuable knowledge upon every subject; and let me tell you that the hands may labor, and the body put forth its utmost strength, but it is only when physical power is directed by the best intelligence that it accomplishes its happiest results. It was once said by a noted southern statesman (McDuffie) that, in order to secure a laborious population, the laborers must be kept in a state of ignorance. In those sections of our country where the free-school system has been longest maintained, and intelligence is most diffused among the people, the condition of things proves the fallacy of such a doctrine. Although in many parts of this great commonwealth the march of mental improvement has been shamefully slow, still, we believe that better times are coming. In this favored neighborhood, the signs of high intelligence and cultivation are conspicuous on every side. A strong proof of this is furnished by the fine displays of stock, farming implements, &c., and by the crowds which have attended this exhibition, all eager to see what is to be seen, and learn whatever may be learned. Do not rest satisfied with the general organization of this county society, but form separate sub-societies or clubs in each township, where the members may meet often at a central point for the interchange of opinions, and have at hand a few of the best standard agricultural books and periodicals to help them onward in the search for the best information upon rural affairs of every kind. A small contribution from each member would enable many to have recourse to works which they might not deem it expedient to purchase individually.

When we wish to convince ourselves of the progress we have made, we look back to points we have passed. A few years ago, how ridiculous would a farmer have appeared if heard talking about carbon, oxygen, ammonia, or nitrogen, sulphates, nitrates, phosphates, superphosphates, ammoniated superphosphates, &c. At the present day, all these terms, which have heretofore been kept in the closet and laboratory, are as familiar as household words. Of Dr. Liebig's *Agricultural Chemistry*, which abounds in the technicalities of science, large editions have been printed and sold in the United States. To this may be added thousands of volumes from Johnson, Norton, and other scientific writers, which, with the very numerous and valuable periodicals in circulation, cannot fail to shed a flood of light through every part of our country, and I sincerely trust that the rich and smiling land which, as I stand among you, bounds my view on every side may share its full proportion.